CREOTERRA

GROUND MOUNT INSTALLATION GUIDE

2014 | EDITION 2.0

UL SUBJECT
2703 RECOGNIZED

CreoTecc
SOLAR MOUNTING SYSTEMS

CREOTERRA GROUND MOUNT INSTALLATION GUIDE

PLEASE REVIEW THESE INSTRUCTIONS BEFORE BEGINNING YOUR INSTALLATION

This manual, in conjunction with the engineering documents provided, will enable the installer to build a code compliant ground mounted solar array, designed in accordance with ASCE 7-05 or 7-10.

Following these instructions will result in a fully grounded and bonded solar mounting system, recognized to UL 2703 standards.

If there are any questions after reading this manual, please call Creotecc Technical Support at (831) 438-9000.

TABLE OF CONTENTS

Installer Responsibilities . . . 3
Tools . . . 3
Resources . . . 3
Layout Information . . . 4
Pile Profile and Tolerances . . . 4
System Components . . . 5
Step 1: Attach Pile Bracket to the Pile . . . 6
Step 2: Insert Slot Nuts into Side Channel of Base Rail . . . 6
Step 3: Attach Base Rail to Pile Bracket . . . 7
Step 4: Cut Insertion Rail . . . 7
Step 5: Connect First Insertion Rail to Base Rail . . . 8
Step 6: Set the Spacing Between Insertion Rails . . . 8
Step 7: Install Splices . . . 9
Step 8: Insert Modules into Insertion Rail . . . 10
Step 9: Insert T-Stops or Foam Spacers . . . 10
Step 10: Grounding and Bonding . . . 11
Step 11: Attach Edge Stops and End Caps . . . 13
Step 12: Manage the DC Wiring . . . 13

INSTALLER RESPONSIBILITIES

The installer is solely responsible for:

1. Complying with all applicable local or national building codes, which may supersede this manual.
2. Ensuring that Creotecc and other products are appropriate for the particular installation and environment.
3. Ensuring that any earth distributed after geotechnical assessment is returned to at least 98% of assessed compaction before construction begins.
4. Using only Creotecc parts and installer supplied parts as specified by Creotecc (substitution of parts may void the warranty and invalidate the letters of certification).
5. Ensuring safe installation of all electrical aspects of the PV array.
6. Ensuring that correct and appropriate design parameters are used in determining the design loads. Factors such as snow load, seismic load, wind speed, exposure and topographic parameters should be confirmed with the local building official or a licensed professional engineer.

REQUIRED TOOLS

- Cordless Screwdriver
- Framing Square or Bosch GPL3T Laser Square
- 2 Spacers (Spacer Length= PV Module Height + 3/8") or a set of CREOSPACERS
- Miter Saw with non-ferrous blade
- Stick Wax or equivalent (I-Beam only)
- String Line
- Tape Measure
- Torque Wrench - 2-25 ft-lbs. range
- Rubber Mallet or Dead-Blow Hammer
- 3/8" Driver bit
- 9/16" Socket and Driver

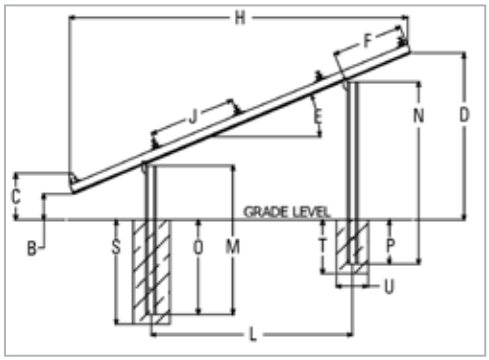
OPTIONAL TOOLS

- >85% pure zinc galvanizing paint
- Anti-seize lubricant
- Drill Driver with approx. 1800 RPM speed and depth sensitive nosepiece - DW 267 or similar
- Saws-All or Porta-Band
- 5/16" Drill bit (pre drilling splices)

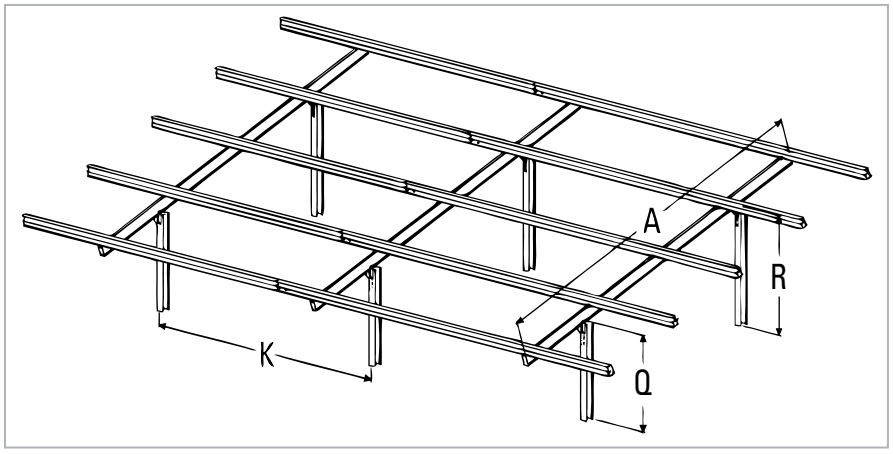
RESOURCES

- Creotecc Customer Support - 831.438.9000
- Creotecc FAQ
- Creotecc Grounding and Bonding Manual
- CREOTERRA Upgrades and Revisions 2014
- Online Training Videos - www.creotecc.us
  - CREOTERRA Installation Video
  - DynoBond™ Grounding and Bonding Video

LAYOUT INFORMATION FOR A 4x13 CREOTERRA ARRAY



(**A**)- Base Rail Length (±1")
(**B**)- Front Clear Height
(**C**)- Module Clear Height
(**D**)- Rear Clear Height (±2")
(**E**)- Array Tilt (±2°)
(**F**)- Base Rail Cantilever-North South (±4")
(**G**)- Array Length (East-West)
(**H**)- Array Width (North-South)
(**I**)- Insertion Rail Cantilever-East and West
(**J**)- Module Pocket Dimension (+1/8"-1/16")
(**K**)- East-West Pile Spacing (±4")
(**L**)- North-South Pile Spacing (±4")
(**M**)- Front Pile Length
(**N**)- Rear Pile Length
(**O**)- Front Pile Embedment Depth
(**P**)- Rear Pile Embedment Depth
(**Q**)- Front Pile Height Above Grade
(**R**)- Rear Pile Height Above Grade
(**S**)- Front Foundation Depth
(**T**)- Rear Foundation Depth
(**U**)-Concrete Foundation Diameter

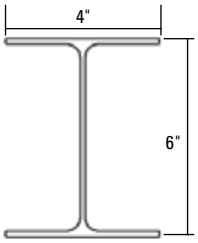


The drawing to the left represents a sample CREOTERRA array. The variables correspond to the array dimensions.

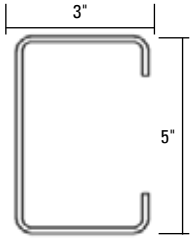
Exact values of each letter are included in your quote as well as in the engineering documents provided by Creotecc.

Individual Pile Location = ± 2" of layout.

PILE PROFILES AND TOLERANCES



W 6x7 or
W 6x8.5 I-Beam



C-Channel

Use only CREOTERRA piles, as they are recognized by UL to Subject 2703. Substitution of other piles may void the warranty and 2703 recognition.

When field conditions dictate, Insertion Rails can "bend" slightly to account for a low or high pile. Limit this condition to a single pile with no more than 2" difference in adjacent pile height per 120" of east-west span "**K**". Creotecc Pile Brackets allow 3/4" height adjustment.

After installing piles, repair any damage to zinc coating with galvanizing paint of at least 85% pure zinc.

PILE TOLERANCES:

Out of Plumb: ± 2˚, East West Shift: ± 2", North South Shift: ± 2", Rotation: ± 5˚, Height: ± 2"

FOUNDATION PREPARATION:

The *Foundation Preparation for CREOTERRA* companion piece describes how to properly set pile elevation on flat and slightly sloped terrains when pouring concrete foundations. Our Pile Bracket enables CREOTERRA to adapt to uniform east-west slopes of up to 8°.

SYSTEM COMPONENTS

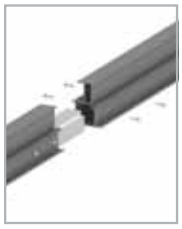
Creotecc uses high quality, corrosion-resistant materials. Information on optional finishes and anodizing is available upon request.

INSERTION RAIL (XL)

Standard rail length: 240"
Standard rail models: 35,40,42,46 and 50 mm
(Custom lengths are available)
Extruded Aluminum

BASE RAIL (XL & XXL)

XL Base Rail lengths: 142" and 175"
XXL Base Rail lengths: 212", 242" and 278"
(Custom lengths are available)
Extruded Aluminum



INSERTION RAIL SPLICE SET (XL 12")

(1) XL Insertion Rail Splice 12", AL
(8) 1/4" x 1" Self Drilling Screws, SS for Rigid Splice
(4) 1/4" x 1" Self Drilling Screws, SS for Expansion Splice

RETAINING CLIP SET (STD or HD)

(1) Retaining Clip, AL
(1) 3/8" x 3/4" Hex Bolt, F593C, SS
(1) Slot Nut, SS

INSERTION RAIL SPLICE SET (XL 18")

(1) XL Insertion Rail Splice 18", AL
(16) 1/4" x 1" Self Drilling Screws, SS for Rigid Splice
(8) 1/4" x 1" Self Drilling Screws, SS for Expansion Splice

GROUND SHARK SET

(1) Upper Ground Clip, SS
(1) Lower Ground Clip, SS
(1) 3/8" x 3/4" Green Hex Bolt, SS
(1) 3/8" Flat Washer, SS
(1) 3/8" Slot Nut, SS

EDGE STOP SET (XL)

(1) XL Edge Stop, AL
(2) 1/4" x 1" Self Drilling Screws, SS w/ Stalgard Coating

T-STOP

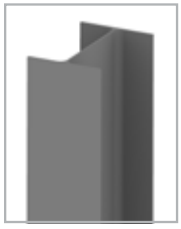
Made of UV resistant EPDM rubber
(Required for systems with a tilt of less than 10°, otherwise optional)

END CAP (XL or XXL)

(1) XL or XXL End Cap, AL

FOAM SPACER

1" x 1" x 1/8" UV resistant Foam Spacer
Latex rubber adhesive
(1 per module in landscape, 2 per module in portrait)



PILE - W6x7 or W6x8.5

Hot dipped galvanized to ASTM-A123 Standard, equivalent to G370
Lengths: 8'-14' and 16'
(Custom lengths are available)

PILE BRACKET SET (STD or HD)

(1) Pile Bracket, Steel w/ Powdercoat
(2) 3/8" Split Lock Washers, AL
(2) Slot Nuts, SS
(2) 3/8" x 3/4" Hex Bolt, F593A, SS

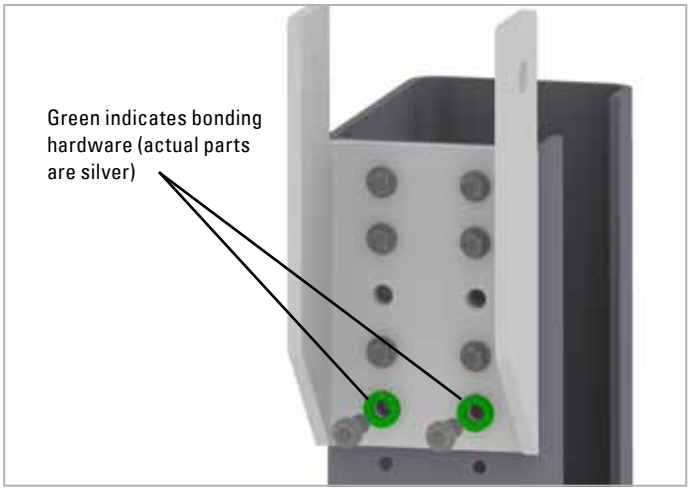
PILE - C CHANNEL

5CS3x135, G235 Galvanized
Lengths: 8'-14'
(Custom lengths are available)

PILE BRACKET ATTACHMENT SET

(6, 8 or 10 pieces)
(6-10) 1/4" x 1" Self Drilling Screws, BF540
or
(6-10) 1/4" x 1 1/8" Self Drilling Screws, DF865 (not UL recognized)
(2) 1/4" Split Lock Washers, AL

STEP 1 - ATTACH PILE BRACKET TO THE PILE

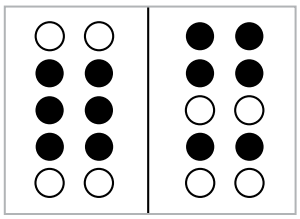


INSTRUCTION:

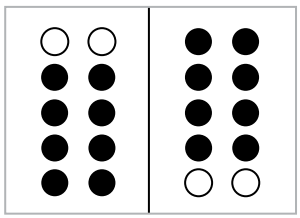
1. Attach the first and last Pile Brackets to the south side of the piles at each end of the array.
2. Use a string line to position all middle brackets.
3. Use two Split Lock Washers (required for bonding) and 6-10 Self-Drilling Screws, torque to 10 ft-lbs.

NOTES:

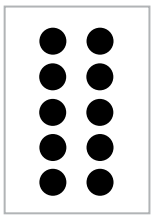
- See quote or design plans for the exact number and location of Self-Drilling Screws.
- Brackets with 6 or 8 screws may be installed 3/4" higher or lower to account for uneven support posts.
- Brackets with 10 screws can be installed 1/4" higher or 3/4" lower than shown.
- Be sure all screws are at least 1/4" from the top of the pile.



6 Hole Screw Patterns



8 Hole Screw Patterns

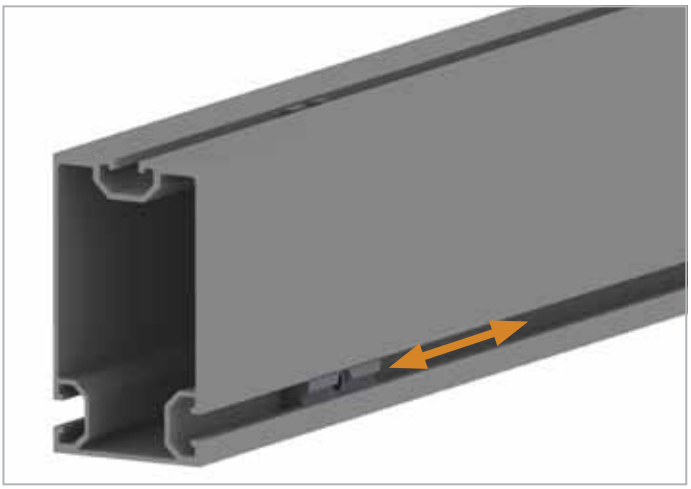


10 Hole Screw Pattern

TIP

- Drive Self-Drilling Screws at high torque and low-medium speeds. To accelerate installation, use Stick Wax or other steel lubricant.
- Use clamps or vice-grips to hold bracket while attaching screws.

STEP 2 - INSERT SLOT NUTS INTO SIDE CHANNEL OF BASE RAIL



INSTRUCTION:

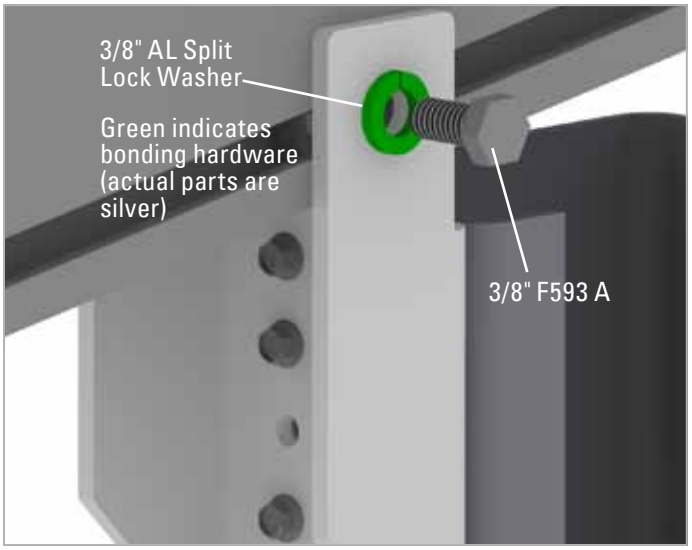
1. Insert Slot Nuts into the slots along the Base Rail (they will stay in place where inserted but can be adjusted).

   Slot Nuts may also be installed in Step 3, depending on project size and installer preference.

NOTES:

- Your quote or engineering documents will specify which size Slot Nuts are required for your installation.
- The distance from end of rail to center of Slot Nut is dimension "**F**" in your quote or engineering documents.

STEP 3 - ATTACH BASE RAIL TO PILE BRACKET



INSTRUCTION:

1. Place the Base Rail into the Pile Brackets, making sure that front and rear cantilever lengths correspond to your design plans (measurement "**F**").
2. Connect the Base Rail to the Pile Bracket using 3/8" Hex Bolts and Split Lock Washers, torque to 25 ft-lbs.

NOTES:

- Pile Bracket Hex Bolts are marked "F593 A" (do not substitute Retaining Clip bolts).
- Control front cantilever to dimension "**F**" and verify rear cantilevers are within ±4".

TIP ▶ To ensure all rails line up evenly, set the east and west Base Rails first and use string to align middle Base Rails. Each Base Rail can shift ± 1/2" north-south using the given Base Rail length "**A**".

STEP 4 - CUT INSERTION RAIL

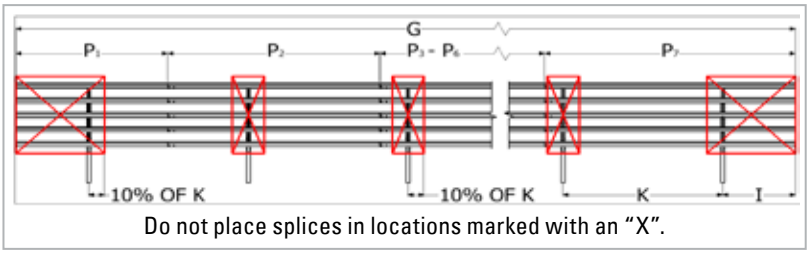
Cutting rails to match array length and control splice locations is usually required for systems below 300 kW. Creotecc's value engineered systems optimize the use of full length rails and reduce the amount of cuts. See dimensions P1 –P7 in your quote or engineering documents for the proper installation pattern of Insertion Rail and Splices.

RAIL AND SPLICE LOCATIONS:

- All 18" splices must be installed in the center 80% of the Insertion Rail span. (Do not install splices in a cantilever area past the outside Base Rails.)
- If 12" splices are specified for your system by Creotecc, they may only be located at 20% ±4" of "**K**" (east-west pile spacing) from any given Base Rail. (Do not install splices in a cantilever area past the outside Base Rails.)
- Any Insertion Rail shorter than twice the cantilever "**I**" must be installed either in the middle of the array or with Rigid Splices.

CUTTING ALUMINUM RAIL:

- Use a miter saw and non-ferrous 70+ tooth blade (do not use a grinding blade on aluminum).
- Blades designed to cut wood can be used in an emergency but are more likely to kick back.
- Cut slowly and use a lubricant such as stick wax for long blade life.
- The bottom of the Insertion Rail should rest on the fence of the saw to prevent kickback.

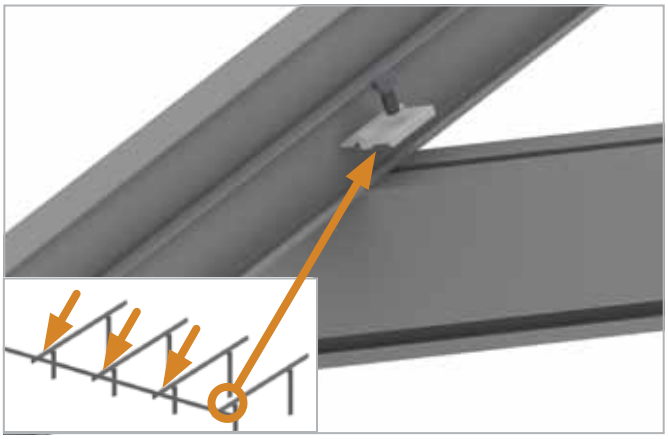


Do not place splices in locations marked with an "X".

CUSTOM RAIL EXTRUSIONS:

Creotecc XL Insertion Rail is stocked in standard 240" lengths. Custom Base and Insertion Rail lengths can be extruded for systems over 300kW. Custom extrusions will use 12" XL Insertion Rail Splices. Please refer to your engineering documents for splice locations, Insertion Rail patterns and installation instructions.

STEP 5 - CONNECT FIRST INSERTION RAIL TO BASE RAIL



TIP
- Be sure to use the bolts marked “F593C” for Retaining Clips.

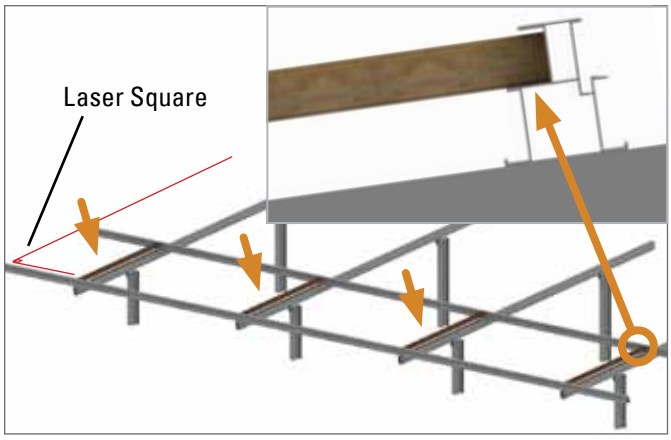
INSTRUCTION:

1. Making sure that the deep pocket opens downhill, place the first (lower most) Insertion Rail 1/2" from the end of the Base Rail.
2. Install a Slot Nut and one Retaining Clip on the uphill edge of the Insertion Rail at each Base Rail intersection, torque to 25 ft-lbs.

NOTES:

- Setting the bottom rail straight is essential since it controls the alignment of the entire array.
- Make sure cantilever length matches the correct plan length (dimension “**I**”). Check cantilever at each end to ensure proper tolerances.

STEP 6 - SET THE SPACING BETWEEN INSERTION RAILS



TIP
- Using a 3 beam laser square Bosch GPL3T will accelerate installation.
- If using wooden spacers, make sure the wood is dry.
- Take special care that each spacer is exactly the correct length.

INSTRUCTION:

1. Measure a module to be installed.
2. Cut at least two wooden spacers (or set CREOSPACER length) to **precisely module height + 3/8".**
3. Place the second Insertion Rail on the Base Rail with the spacers snug in the module pocket along the length of the Base Rail.
4. Use a framing square or laser square to ensure rail ends are square to the first Insertion Rail.
5. Install two Retaining Clip Sets (one above and one below each Base Rail intersection) at all internal Insertion Rails, and torque to 25 ft-lbs. (Use a spacer when tightening to ensure rails are parallel).
6. Repeat spacing for all Insertion Rails.

The top Insertion Rail requires only one Retaining Clip set on the downhill edge under the PV module, torque to 25 ft-lbs.

NOTES:

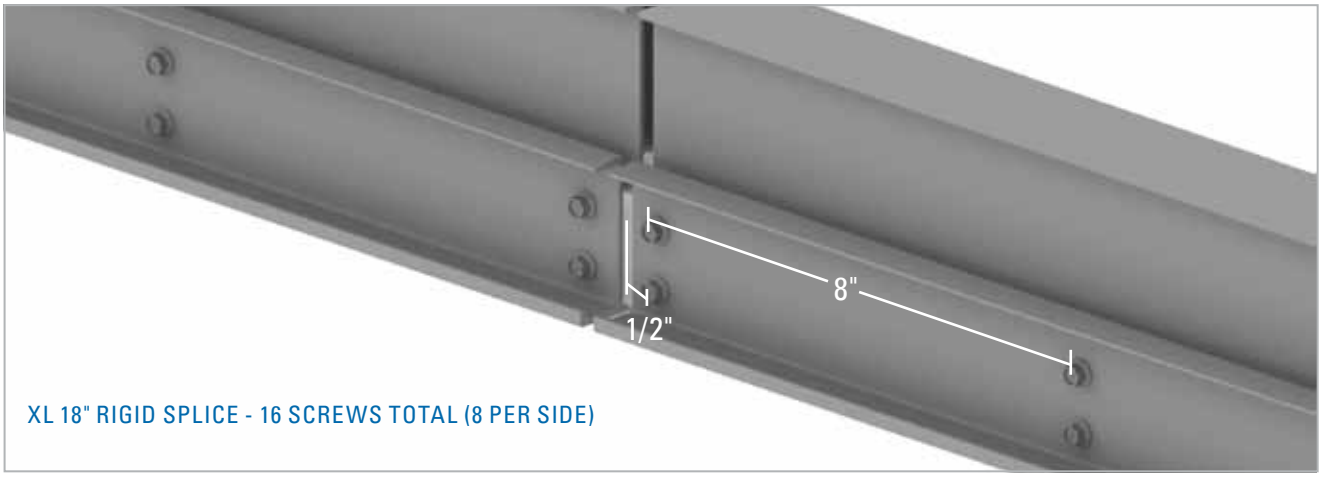
- When squaring the Insertion Rail ends, do not rely on measuring to the Base Rail as a square reference. ALL Insertion Rails need to be square with the bottom Insertion Rail.
- Wooden spacers should be approximately 1" x 1" in width. Larger sizes (such as 2x4) will work, but should be trimmed to just 1" wide with a miter cut at each end.
- Top and bottom Insertion Rails must have one Retaining Clip installed under PV modules.

STEP 7 - INSTALL SPLICES

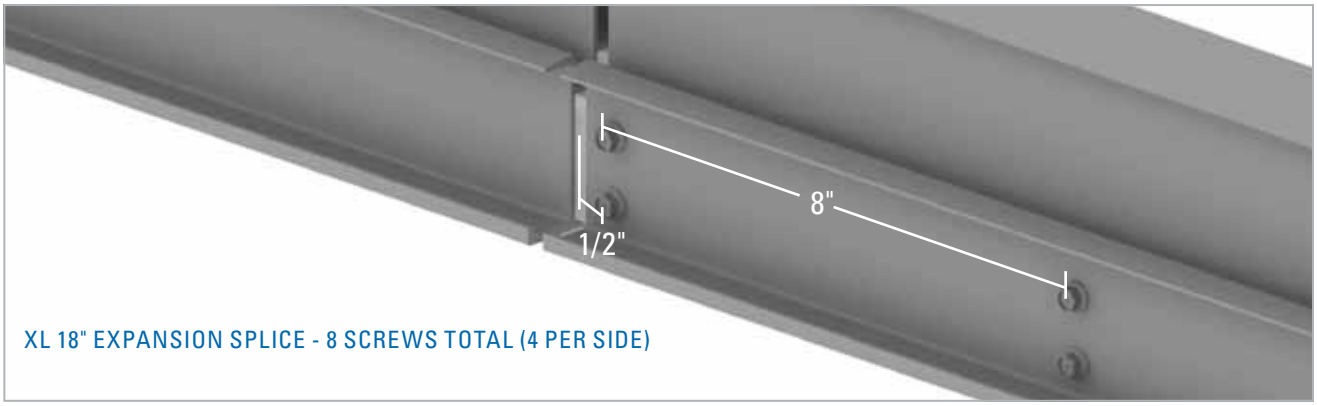
Your engineering documents will specify splice length, placement and instructions related to your array. Refer to them before preceding. Most systems utilize 18" splices, however 12" splices are specified for custom rail extrusions.

INSTRUCTION:

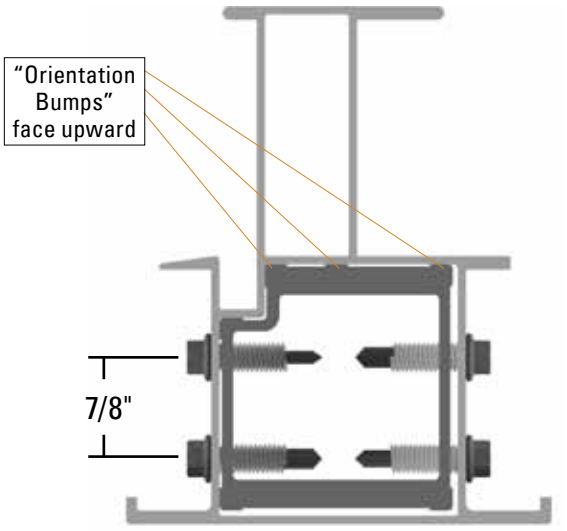
1. Insert one end of the splice into Insertion Rail and attach with 1/4" SDS screws. 18" splices should be inserted 8-7/8" into rail; 12" splices should be inserted 5-7/8" into rail.
2. Place the next length of rail over the other side of the splice, leaving a 1/4" gap between rails.
   A. Rigid Splices are then attached to second rail.
   B. Expansion Splices are not attached to allow for thermal expansion.



XL 18" RIGID SPLICE - 16 SCREWS TOTAL (8 PER SIDE)



XL 18" EXPANSION SPLICE - 8 SCREWS TOTAL (4 PER SIDE)



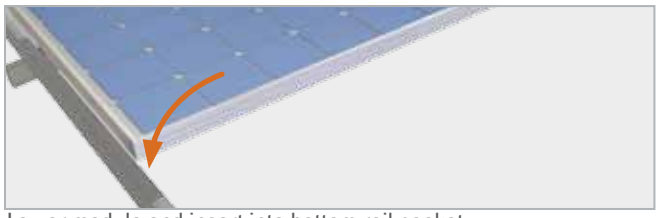
NOTES:

- Torque for all splice screws is 3 ft-lbs.
- Systems with only Rigid Splices must use foam bumpers for 1/8" gap between modules.
- Any Insertion Rail shorter than twice the cantilever "**I**" must be installed either in the middle of the array or with Rigid Splices.
- Pre-drill Insertion Rails as needed with 11/64" bit.

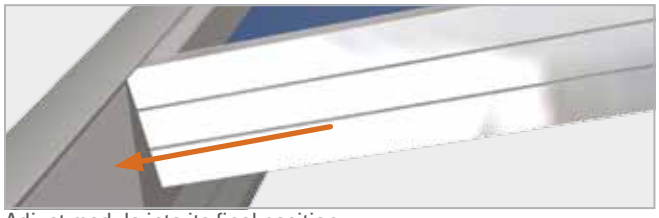
TIP ▶ Retaining Clips make a perfect spacer between rail ends. Remove them after Insertion Rail is attached.

STEP 8 - INSERT MODULES INTO INSERTION RAIL

Insert the module at a slight angle into the top Insertion Rail.



Lower module and insert into bottom rail pocket.



Adjust module into its final position.

INSTRUCTION:

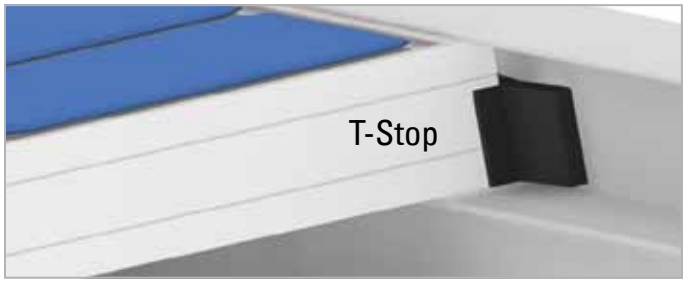
1. Beginning at one end of the array, insert the upper edge of the module into the upper Insertion Rail at a slight angle.
2. While placing the module fully into the upper rail, allow the lower edge of the module to tilt down and rest in the lower rail pocket.
3. Position the module so that it seats fully in the lower Insertion Rail pocket.
4. Install the next module and slide it gently over until the frame touches the bumper of the previous module.

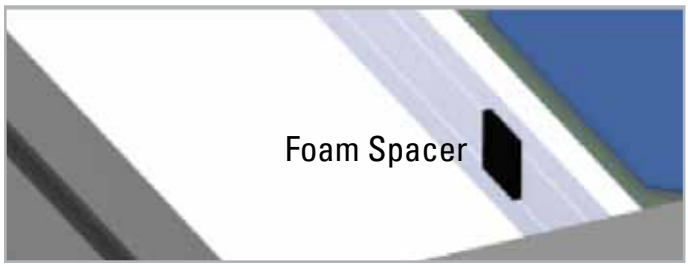
NOTES:

- Ensure that modules are seated properly, especially at splice locations and areas where the Insertion Rail flexes heavily, such as any high or low piles.
- Trim Insertion Rails if necessary for an aesthetic appearance. Leave 1/8" of space from module to Edge Stop.

TIP
- When sliding modules east-west, push from the bottom edge of the frame.
- When installing the next row of modules, line up module frames with the rows above or below.

STEP 9 - INSERT T-STOPS OR FOAM SPACERS





TIP
- For greater efficiency, install spacers on modules as soon as they are unboxed.

INSTRUCTION:

1. On systems with less than 10° tilt, install one T-stop in the upper Insertion Rail between each module.
2. On systems that don't use T-Stops, we recommend Creotecc Foam Spacers to maintain an inter-module spacing of 1/8". For landscape orientation, place one spacer to the midpoint of each module (along the short side). For portrait orientation, place 2 spacers on each module 4" from top and bottom (along the long side).

NOTES:

- The rubber adheres best to dry surfaces in temperatures above 20°F. Do not leave spacers outside overnight, as adhesion may be reduced.
- Some module manufacturers require more than 1/8" gap between modules. Check the manufacturer installation manual for your specific module.

STEP 10 - GROUNDING AND BONDING

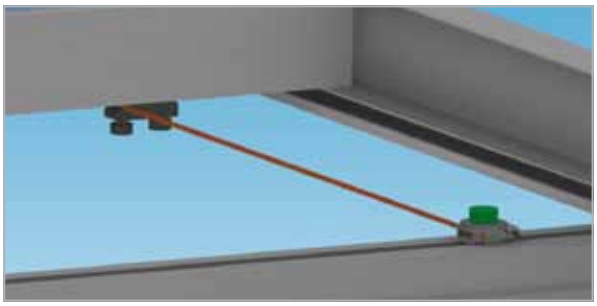
Framework Grounding

The CREOTERRA mounting system, when assembled according to this manual, creates a bonded grid. No additional grounding hardware is required other than a Creotecc Ground Shark. To connect a bonded table to ground, simply run a bare copper wire from a Ground Shark to the main system ground, GEC, inverters and/or combiner boxes. All connections are designed and tested to ensure long term bonding continuity and a low resistance electrical connection in outdoor environments. All grounding and bonding methods described in this manual are UL 2703 Recognized.

Ground Shark Installation

1. Install the Slot Nut into the Base Rail.
2. Place the washer and both upper and lower clips on the bolt.
3. Run bare copper wire into lower clip. Ensure either AWG #6 or #10 wire uses the appropriate slot in the lower clip.
4. Tighten the 3/8" bolt to 20 ft-lbs.

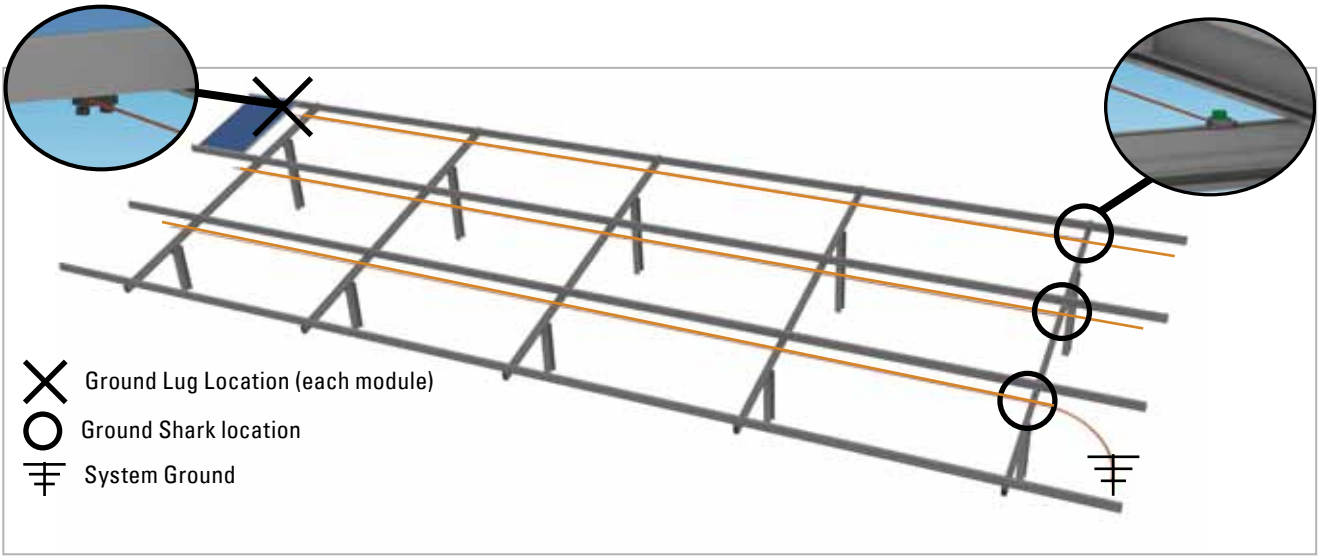
TIP ▶ A Ground Shark may be installed anywhere along the top slot of the Base Rail. It may also be installed at the intersection of Base and Insertion Rails when the rails are not otherwise bonded.



Connect up to 45 amps of PV module strings to any Base Rail.

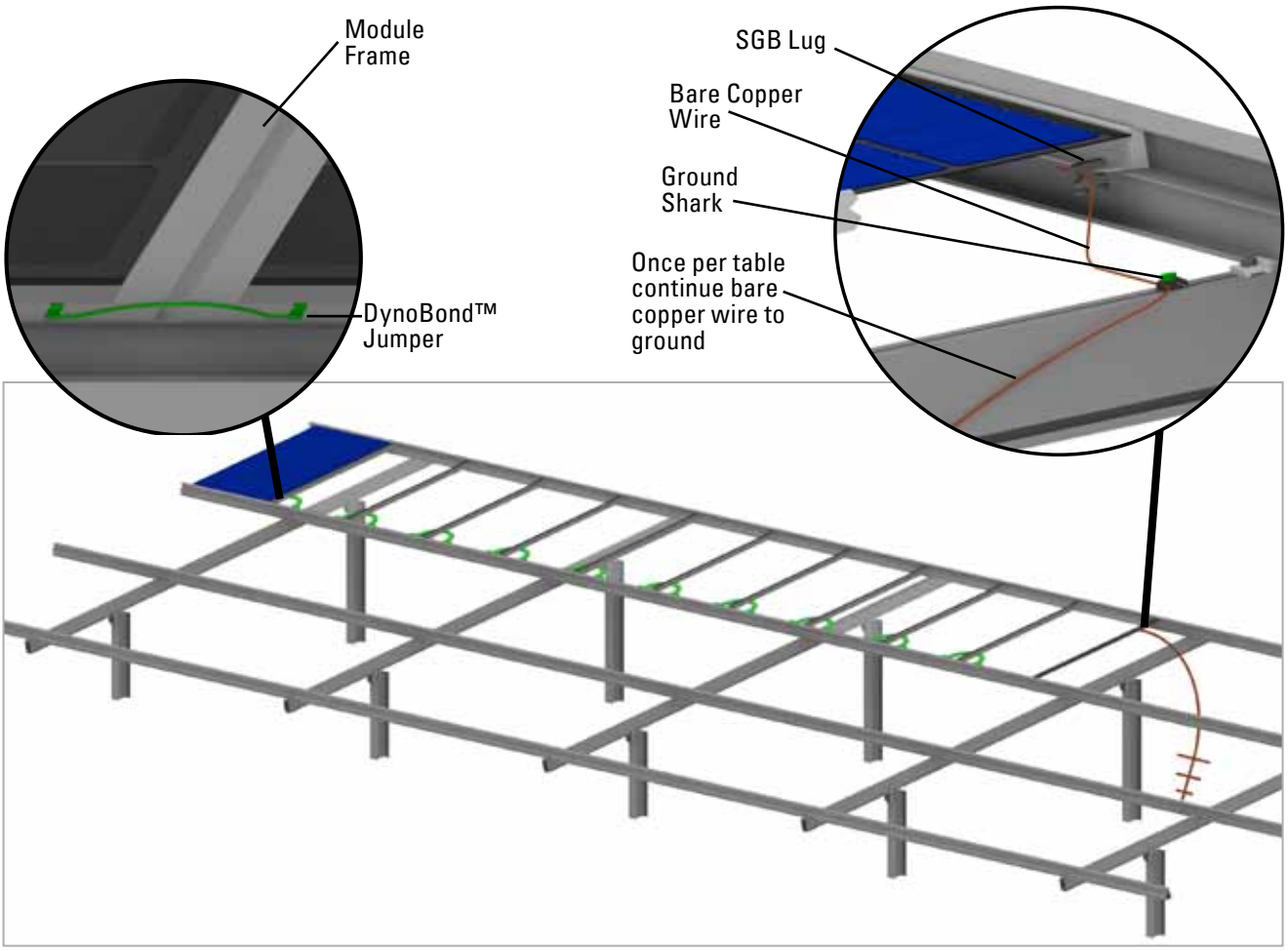
Module Grounding Option #1: Lugs and Bare Copper

1. Attach one UL or ETL approved ground lug to each PV module prior to module installation.
2. Run AWG #6 or #10 bare copper wire through all lugs and each row of modules.
3. Run the copper wire to a Ground Shark and attach to any Base Rail. One Ground Shark is required per 45 amps of PV Module OCPD.
4. Typically 2-3 strings of modules can connect to one Ground Shark.



Module Grounding Option #2: DynoBond™

1. Attach a DynoBond™ jumper between each module frame in a PV string. Tap with a rubber mallet to seat jumpers.
2. Attach one approved ground lug to any module, and near a XXL Base Rail.
3. Attach one Ground Shark to the Base Rail and connect Ground Shark to ground lug with a short AWG #6 or #10 solid bare copper wire.
4. Repeat for all PV strings within each table.



TIP

- Watch the brief DynoBond™ Grounding Video online at www.creotecc.us.
- When part of a string needs to be connected to the next row of modules, use a longer 38" DynoBond™ jumper.
- The DynoBond™ may be installed on any exposed edge of the frame, but the lower edge is preferred.

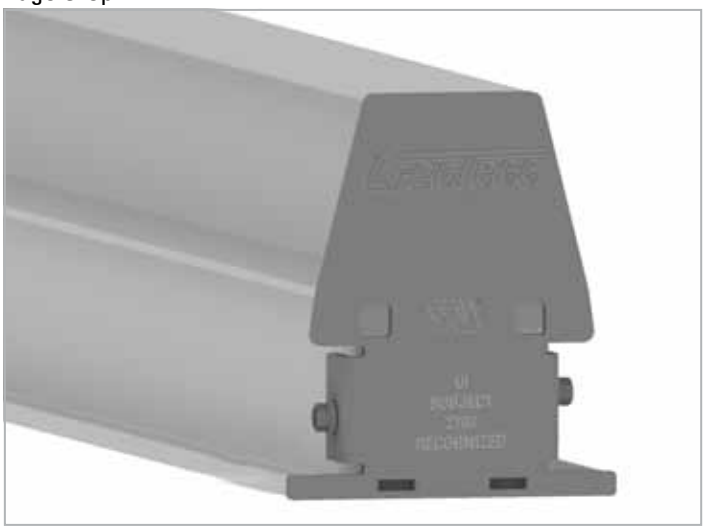
All module and framework grounding and bonding methods described in this manual are UL 2703 Recognized.

STEP 11 - ATTACH EDGE STOPS AND END CAPS

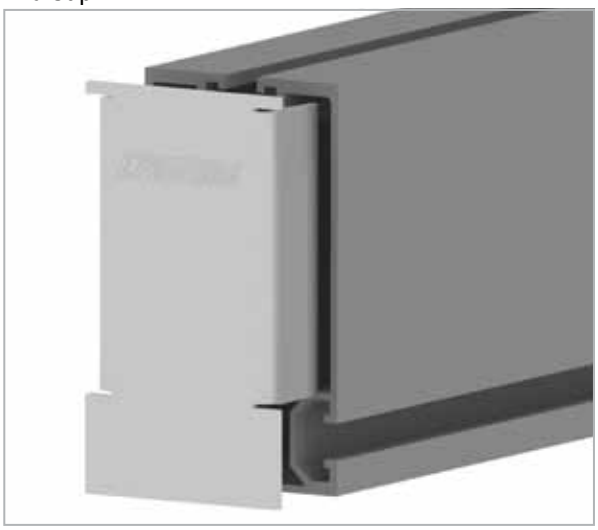
INSTRUCTION:

1. Insertion Rail: place Edge Stops into position and attach using two 1/4" Stainless Steel Self Drilling Screws in the holes provided; torque to 2 ft-lbs.
2. Base Rail: while squeezing the tabs, insert the End Cap into the open end of the Base Rail and tap it gently with a rubber mallet until it sits flush against the Base Rail.

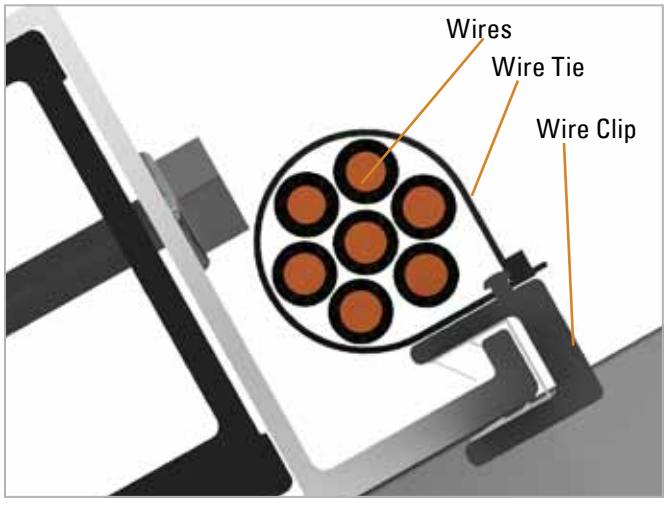
Edge Stop



End Cap



STEP 12 - MANAGE THE DC WIRING



INSTRUCTION:

1. Collect the wires at the edge of the Insertion Rail so that the weight of the wire is supported by the Insertion Rail lip.
2. Push the wire clip over the lip of the Insertion Rail, making sure the wire tie is closest to the module.
3. Remove slack from wires and pull the wire tie tight.

NOTES:

- The wire clip manages up to 2" diameter of DC wire along the east-west length of your array (approximately 40 AWG #12 wires or 60 AWG #14 wires).
- Install at least one wire clip per module.

For large bundles of wire, ask about our wire management trays.

CREOTECC

SOLAR MOUNTING SYSTEMS

CREOTECC US
11 Janis Way
Scotts Valley, CA 95066
831.438.9000
www.creotecc.us
info@creotecc.us

CREOTECC GERMANY
Bebel Strasse 6
79108 Freiburg
+49 761 21686-0
www.creotecc.com
info@creotecc.com